

ART. XVIII.—*Machine-Made Line Drawings for the Illustration of Scientific Papers*; by R. A. DALY.

It is safe to say that the majority of persons, who from time to time publish scientific papers, are seriously hampered in the preparation of text illustrations by the difficulty and expense entailed in the tedious drawing of map, section or diagram. Comparatively few authors can command the services of skilled draughtsmen or have themselves the requisite training to produce satisfactory line drawings. Yet the desirability of greatly increasing the proportion of such illustrations in the thousands of scientific articles published each year is manifest. That clearness, precision and conciseness in the exposition of a theme are generally enhanced by the use of abundant, appropriate diagrams is as evident as that the blackboard is the constant friend of the teacher of any branch of natural history or philosophy; the printed page needs its blackboard.

Ideally, the author should himself be able to make the original drawing quickly, neatly and artistically. The usual execution of drawing with the pen is, to the average author, discouragingly slow and expensive, not always neat, and still less often artistic. The following note relates to some experiments made to increase rapidity and neatness in the production of line drawings by the use of a machine. At the outset the experiments were, for obvious reasons, planned without any idea of rivalling the artistic work of the pen in a skilled hand. The aim has been to secure economy of time in execution and clear-cut precision of legend for the drawing. In both these respects enough success has been attained to warrant the recommendation of the machine method to geologists, geographers and others who desire to prepare useful text illustrations at a minimum cost of labor. Some experimental drawings were made and published in the *Bulletins of the Museum of Comparative Zoology at Harvard College*, vol. xxxviii, 1902, pls. 11, 12 and 13; in this *Journal*, August 1903, pp. 118 and 120; and in the *American Geologist*, August 1903, p. 66. The machine there used was an ordinary Underwood typewriter fitted with a black record silk ribbon.

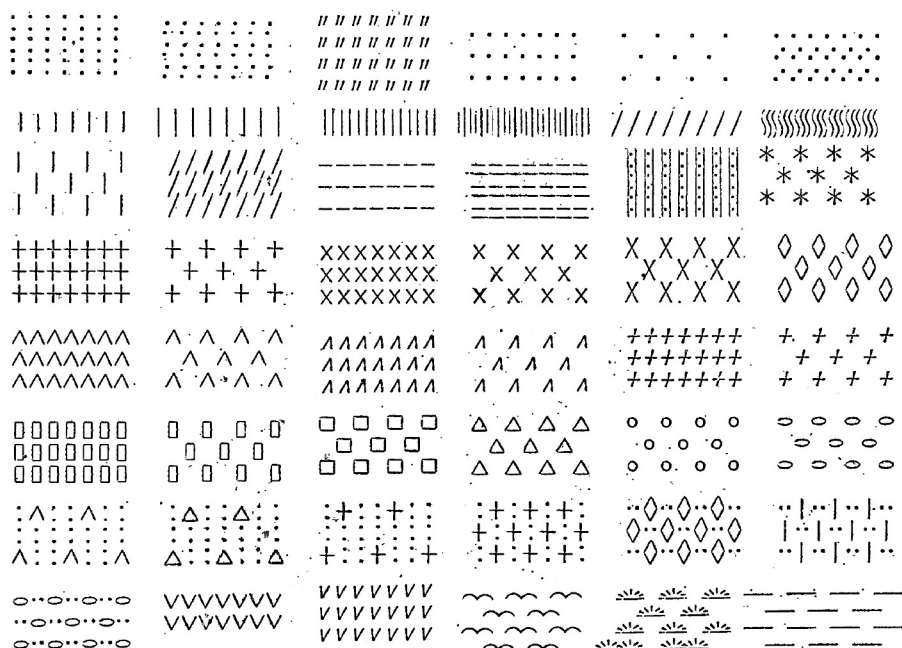
Recently the Hammond Typewriter Company of New York has constructed, for the Geological Survey Department of Canada, from the writer's specifications, a typewriter provided with a carbon ribbon and with ninety special characters designed for the preparation of line drawings to accompany geological and geographical papers. The same machine can be similarly used for statistical, engineering and other diagrams of a more or

less mechanical and simple composition. Of course this method should not wholly replace the use of the pen, even, for example, in the differentiation of areas in a geological map or section. The ultra mechanical look of the typewritten legend can often be pleasingly relieved by the easily and quickly applied cross-hatchings, etc., made with an ordinary drawing pen. In com-

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A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z				
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z				
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z				
1	2	3	4	5	6	7	8	9	0											1	2	3	4	5	6	7	8	9	0
Locality marks																		⊙	⊙	X	⊕	□	▢	▢	*				
Triangulation station etc																		↑	└	△	△	▲	⊙						

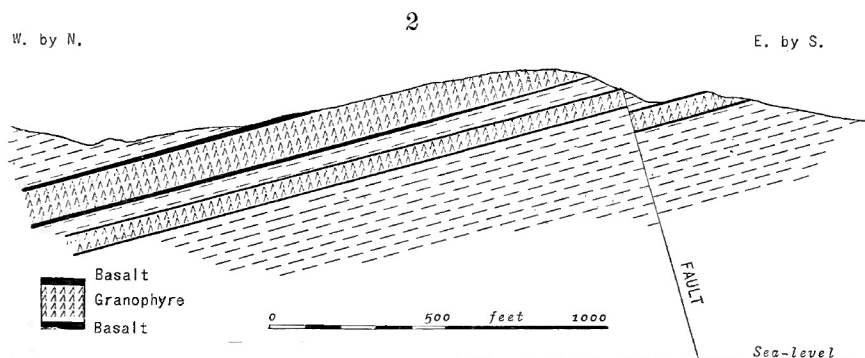
Samples of general purpose legends



plex diagrams free-hand work may generally be expected to supplement the work of the machine. The subject of each diagram should thus be studied with the end of securing suitable contrasts of legend along with the maximum economy of pen work; yet some pen work is almost always necessary.

The typewriter has its most general application in lettering, that most difficult element in line drawings. The machine used by the writer has the advantage of making it possible to employ a great range of type styles. With the carbon ribbon the writer has found that any one of the one hundred and

twenty-five shuttles made for such a machine (each shuttle bearing ninety characters and including the lettering for one of twenty-six different languages), will give an impression suitable for photographic reproduction. Each shuttle can be placed in the machine ready for work in a few seconds. The usual silk ribbon gives a "woolly" line, and is far less satisfactory than the carbon ribbon. A highly calendered and high-grade linen paper of a medium to heavy weight or a thin Bristol board may be recommended. Often more than one impression of the key is necessary to obtain the required depth of tint for photography; such repeated impressions can be made at great speed by employing a back spacing key. Care must be taken not to smudge the carbon of the completed printing.



The accompanying cuts serve to show something of the method as applied to geological diagrams. The diagram (fig. 1) of alphabets and legends has been reduced to four-fifths of its original diameter. The legends are intended to represent a few examples of those possible with the machine. They can be indefinitely increased in number and varied in design by the engraving of new characters on the shuttle, and by using various permutations and combinations of the existing characters. The section (fig. 2) is reduced to about one-half of its original diameter. It was copied from Harker's section of a composite triple sill published in "The Tertiary Igneous Rocks of Skye" (Memoir of the Geological Survey of the United Kingdom, 1904, p. 204). The result represents the saving of from seventy-five to ninety per cent of the time required by a draughtsman to duplicate the drawing.

It is to be understood, of course, in the preparation of a diagram that an outline drawing is first prepared, and that the spaces thus formed are filled with the symbols shown in the legends, by means of the machine.

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